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# ELEMENTARY SHOP PRACTICE.

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## II. TOOLS FOR TESTING WORK.

Of all angular measurements, that of 90°, or the right angle, is the most common. In order to be able to accurately lay out and test this angle, the machinist uses what is known as a square. The simplest form is called the flat or plate square,

Fig. 9. Steel Squares.

and is similar to two rules held at right angles so that they can lay flat on the work. Both blades are usually of the same length, and one is graduated on its inner edge, while the other has graduations on its outer edge. This form is not hardened and is principally used for laying out, and not for testing. The square for testing is called the try square, and has one side made much thicker than the other; the thick portion being called the beam, and the thinner part the blade. The beam is to be placed against the work and the blade brought down to the surface to be tested. When the outer edge of the blade is graduated, the instrument is called a graduated try square, and the size of the square is designated by the length of the graduated side of the blade; in the plain try square, the size is taken as the length of the inner edge of the blade. All good try squares have hardened blades, accurately ground, and consequently form one of the most expensive, as well as the most important portions

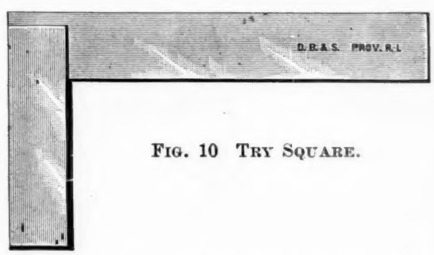


Fig. 10 Try Square.

of a workman's kit. Other fixed angular gauges are sometimes used, usually home-made, and not as accurate as the square. Gauges for the adjacent sides of a hexagon, octogon, etc., and special angles are often seen in modern shops.

Unless the same angle is to be constantly tested, it is better, and certainly cheaper, to use what might be called an adjustable angular gauge. This tool, which is called the bevel, is capable of an infinite number of adjustments, and can be used in many places and for many purposes where a fixed gauge would be not only costly but inconvenient. The style of bevel usually found on a woodworker's bench has a straight slot in the blade, and cannot be set to the small angles some-

times required in machine work. The bevel shown in the cut has a blade and slot shaped like a letter L, enabling the blade and stock to be set parallel to one another, and therefore gives the instrument a wider range of adjustment. One of the latest styles has an extra blade, which can be attached when required, and which adds greatly to its value, as the number of combinations is largely increased.

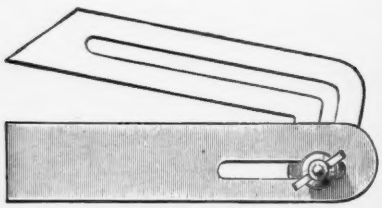


FIG. 11. BEVEL.

Any of the fixed angular gauges, (and the bevel when set, may be termed a fixed gauge), will show clearly when an error exists, but they will not indicate the amount of the error. Futhermore, the common bevel can only be set to a desired angle by having a suitable form on which to test it. Both of these defects would be avoided by the use of what might be termed an indicating bevel. Such a tool we have in the bevel protractor, an instrument which is almost indispensible to the up-to-date machinist. The arc is graduated as fine as one degree, and can be easily set to one-quarter of a degree or 15′. As the blade in the protractor is usually adjustable as to length, it readily lends itself to many operations besides those of determining angles, such as, for example, measuring the depth of holes and slots.

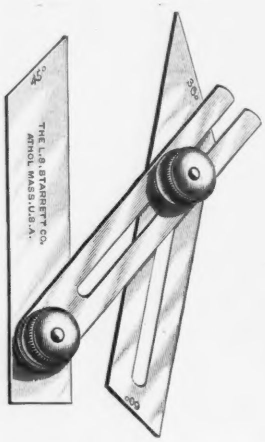



FIG. 12. COMBINATION BEVEL.

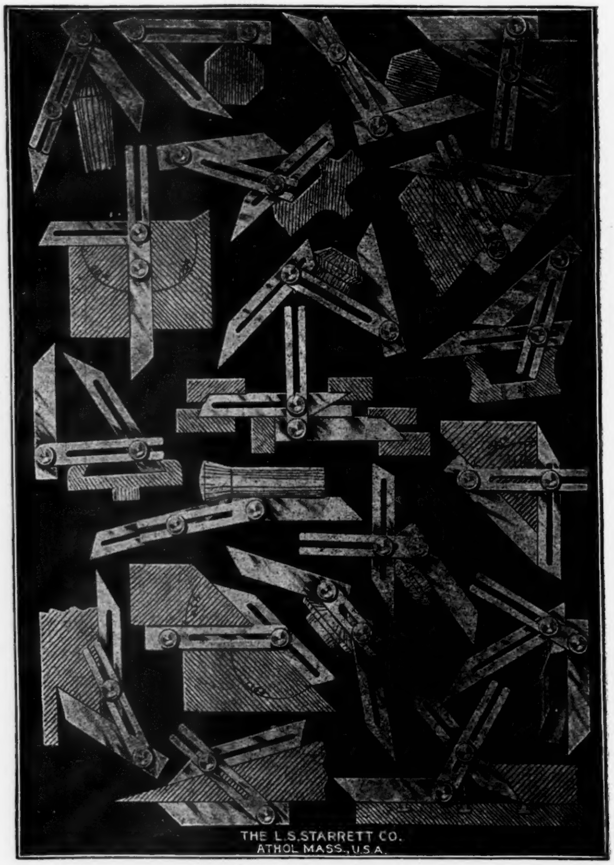



FIG. 13. SHOWING USES FOR A COMBINATION BEVEL.

The combination set shown in Fig. 14 will permit of all the operations mentioned above. The rule can be used in connection with the square,

which also carries a mitre or fixed gauge of 45°, or with the protractor, which performs all the duties of a plain bevel. The level on the square can be used alone for horizontal surfaces, or, in connection with the rule, for plumbing vertical surfaces. The small separate level can be used

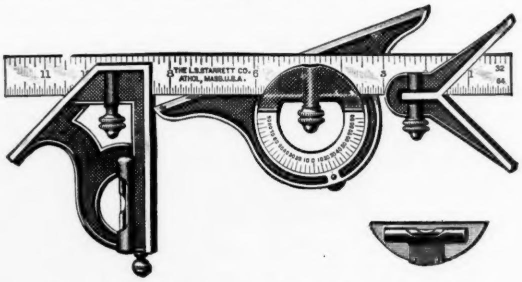


Fig. 14. Combination Bevel Protractor.

in connection with the protractor to determine how many degrees a given surface varies from the horizontal or perpendicular. While the remaining attachment shown, the square bisected by the rule, is generally used for a single operation, the frequency of that duty makes it a valuable addition. It is called the centre square, and is used to locate the centre of round bars or discs. It is based on the fact that the bisector of two intersecting tangents passes through the centre of the circle. When the two sides of the square are pressed against the bar or disc, a line drawn along the rule passes through the centre of the circle, and, by shifting the square 90°, another diameter can be drawn at right angles to the first. At the intersection of these lines will be found the center of the circle.

For drawing circles, a pair of dividers should be used. These are classed by the style of the joint, and the length of the leg from the centre of the pivot. The different joints are the friction, lock joint, wing and spring. The spring deviders, alone, are illustrated, as they are more accurate and convenient than the other forms. The length of the leg varies from 2½″ to 10″. Large circles can be drawn by means of trammel points attached to a wooden or metallic beam. One of the best forms is shown with a very short beam, in Fig. 16. The points of dividers should be hardened and kept sharp.

Fig. 15.
Dividers.

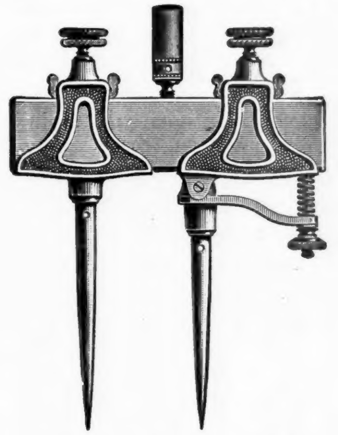


Fig. 16. Trammel Points.

Calipers, for testing distances between surfaces, are very similar to dividers with the legs bent as shown, but not usually hardened. Spring calipers are made from 2½″ to 8″, while the friction type can be had up to 24″. These sizes refer, as in the dividers, to the length of the leg, and not to the capacity of the instrument.

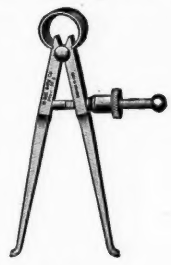


Fig. 17.
Inside Calipers.

Fig. 18.
Outside Calipers.

The simplest form of cutting tool is the chisel. All the forms used by the machinist are termed cold chisels, and three general types are in common use; the flat, the cape, and the round nose. For what might be called comparatively coarse work, they should be from 6″ to 8″ in length, and made from octagonal stock, not less than ⅝″ in diameter. A grade of tool steel, costing about eight cents a pound, is suitable for this purpose, and after forging to proper shape, should be hardened, and then drawn to a purple. The

angle of the cutting edge depends largely on the metal to be cut, and should be about 70° for cast iron, 65° for tool steel, and 60° for mild steel and wrought iron. The use of the different forms is as follows: the flat for ordinary work and all surfaces which are narrower than the face of the chisel; the cape for slots, such as key-ways, and for cutting channels through a surface to be finished with the flat chisel; the round nose for all concave surfaces and for round-bottomed slots, such as oil-grooves.

FIG. 19. CHISELS.

Although the hand chisel is not in use to any great extent in modern shops, it is of value to the amateur on account of the usually limited equipment at his command. Many plane surfaces that would ordinarily be finished on a shaper or planer, can be very satisfactorily trued up by use of the chisel and file, while the smoothing up of castings, etc., usually called "snagging," is still done by use of these tools in many shops of good repute. Therefore, we will take up, first, the process of snagging, and afterward the production of plane surfaces by the use of hand tools alone.

Any work to be chipped must be held firmly in the vise, as the repeated blows of the hammer on the chisel tend to move the work, and thus lose part of the effect of the blow. When possible, it is best to let the work drop to the bottom of the gap, thus resting on the top of the movable jaw, and to chip at right angles to the jaws. An observance of these two precautions will render it unnecessary to set up the vise as tightly as would otherwise be the case, and thus avoid the danger of injury to the vise and distortion of the work. This last fault is particularly noticable when working on surfaces designed to be flat. While snagging need not be very accurate, it is well to practice on such work in order to get familiar with the tools before attempting to produce true surfaces. One of the beginner's greatest difficulties is to avoid striking his thumb. To prevent this, the workman should stand with his feet at right angles and about 8″ apart, thus affording a firm base, and far enough back from the vise so as to lean toward the work a trifle. It is also important to look at the point of the chisel rather than at the head. This may seem strange, but the general sense of direction will carry the hammer to the head of the chisel, while it is necessary to see that the point is in position to do work. A deeper chip can be carried in cast iron than in either steel or wrought iron; say about $\frac{3}{32}''$ in cast iron, and $\frac{1}{16}''$ in the more tenacious metals. On account of the peculiar nature of cast iron, the presence of grease of any kind is to be strictly avoided; even rubbing the fingers on the work makes it difficult for the chisel to bite readily. In chipping wrought iron and steel, on the contrary, the chisel point is frequently moistened with oil in order that the chip may roll up without too much friction. Cast iron is so brittle that the chips break off in small pieces, and are apt to fly some distance from the work. Metals like copper and brass can be chipped with a chisel of even smaller angle than that used for wrought iron, about 45° or 50° being usually employed.

It may be stated as a general proposition that in all cutting tools the cutting angle is made as small as possible, the limiting feature being the ability to hold an edge under the power applied. Another important point to remember, especially in taking light or finishing cuts, is *that it is impossible to remove small chips with dull tools.* This means frequent and careful grinding, and brings us to a consideration of the best means for

sharpening the above-mentioned chisels and shop tools in general.

The most efficient agents for removing metal by grinding are carborundum, an artificial product, and natural corundum and emery. These are crushed and sifted into different grades of fineness, mixed with some form of holding bond, formed into wheels of various diameters and width of face, and baked at a high temperature. These wheels should be carefully balanced and run at a surface speed of about 5,000 feet per minute. They may be used either wet or dry, and if used dry great care must be taken that the temper of the tools be not drawn. For general shop purposes, grades from No. 36 to No. 50 are most suitable, although they can be had as coarse as No. 8, and as fine as No. 120.

Next in order of fineness comes the grindstone, a natural stone, quarried and shaped from the solid. These stones vary greatly in hardness, but a comparatively hard stone should be used in connection with an emery wheel, as there is but little metal to be removed, and the surface will be left in better condition. The speed of grindstones should be as high as possible without causing the water to fly off (grindstones, by the way, are always used wet), and this point is reached between 600 and 800 feet per minute. In setting up new stones, especial care should be taken not to wedge them on the shaft too tightly, as cracks might be started at the corners of the square hole which would wreck the wheel and everything in its line of flight.

For convenience in use, as well as for balancing purposes, all wheels should be kept true. Many mechanical truing devices are on the market, but a fairly good job in this line can be done with a piece of $\frac{3}{8}''$ gas pipe, held "end on," over a stiff rest and slowly rotated across the face of the stone.

When grinding tools, the fingers, not the tool, should be in contact with the rest, and the wheel should always run *toward* the cutting edge, thus preventing the formation of what is known as a "feather-edge."

# QUARTER H. P. HORIZONTAL ENGINE.

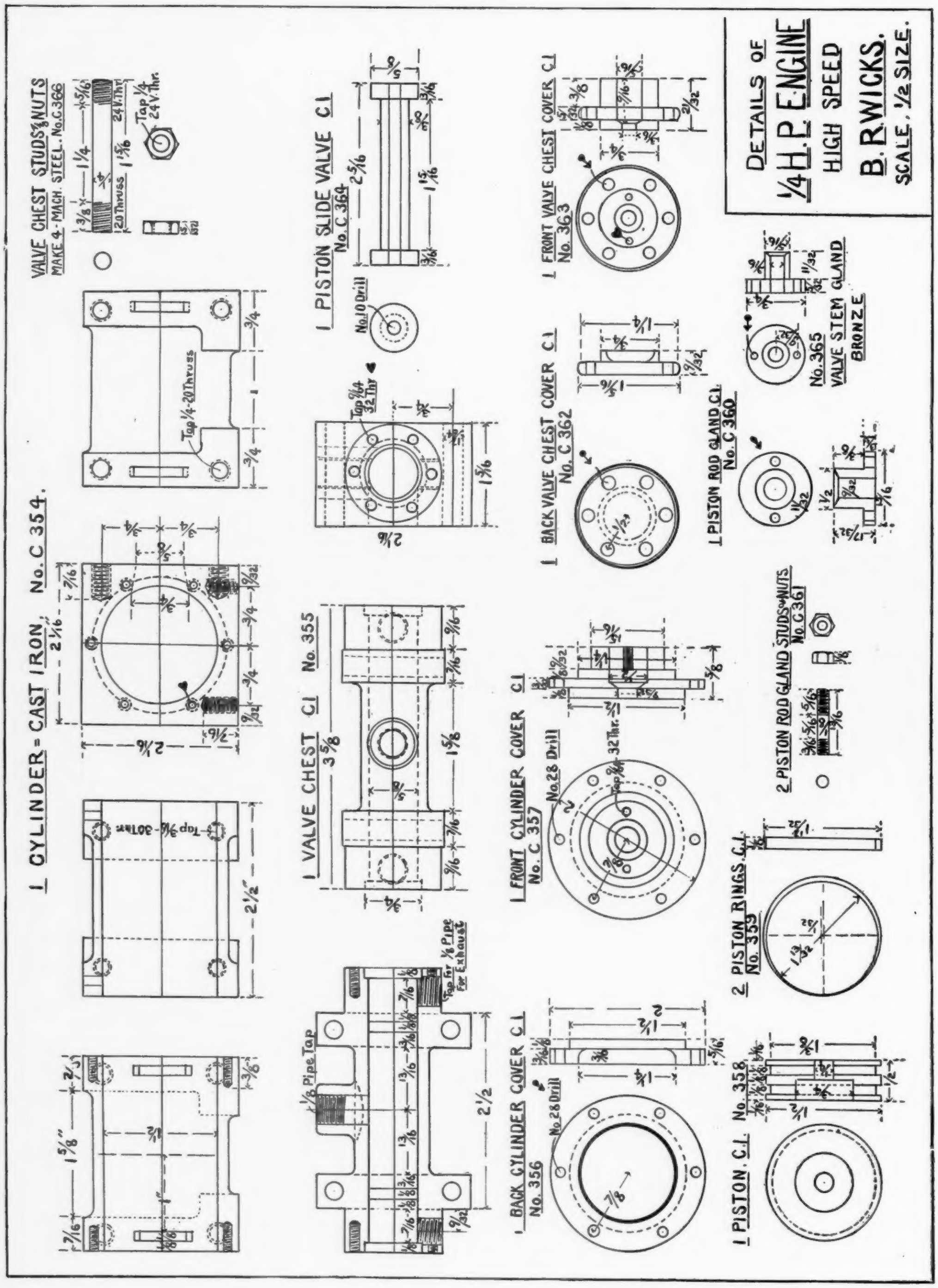
B. R. Wicks.

## I. THE CYLINDER.

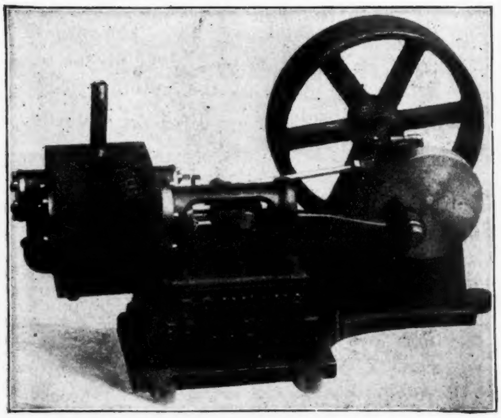
It is intended in this series of papers to furnish the reader with a practical design accompanied with working drawings and a full discription of how to build, from a set of castings, a $\frac{1}{4}$ H. P. horizontal, side-crank, steam engine. The engine has been designed especially for building with the tools usually possessed by the amateur mechanic. The construction is very simple, all the parts are separate from each other and held together by means of machine screws of ample size and length. Also, the size and style of this engine is not too small to be of practical use when built, and not too large to be handled to good advantage in the making.

For the sake of clearness, this description is divided into different headings, each piece and the work upon it being described. Castings will be required as follows: One each, cylinder, valve chest, back cylinder cover, front cylinder cover, piston, casting for making two piston packing rings, piston rod gland, back valve chest cover, front valve chest cover, piston slide valve, valve stem gland, cross head guide, cylinder bracket, crank-disc, bed, fly-wheel, eccentric, eccentric-strap, connecting-rod, wrist-pin bushing, crank-pin bushing, piston rod and cross head, and two each, main bearings and main bearing caps, and cross head adjusting shoes. Also steel for making shaft rods and the pins and screws with which to put the finished parts together.

Work will begin with the cylinder shown in the illustration as *C*, No. 354. In this casting is a $1\frac{3}{8}''$ cored hole which is to be bored out to $1\frac{1}{2}''$, the size of the drain of the cylinder when finished, This casting can be bored out by being held by the square flange in a four-jawed chuck. As


DETAILS OF
1/4 H.P. ENGINE
HIGH SPEED
B. R. WICKS.
SCALE, 1/2 SIZE.
1 CYLINDER - CAST IRON, No. C 354.
VALVE CHEST STUDS & NUTS
MAKE 4 - MACH. STEEL. No. C 366
1 PISTON SLIDE VALVE C.I.
No. C 364
1 FRONT VALVE CHEST COVER C.I.
No. 363
1 VALVE CHEST C.I. No. 355
1 BACK VALVE CHEST COVER C.I.
No. C 362
1 PISTON ROD GLAND C.I.
No. C 360
No. 365
VALVE STEM GLAND
BRONZE
1 FRONT CYLINDER COVER C.I.
No. C 357
2 PISTON ROD GLAND STUDS & NUTS
No. C 361
1 BACK CYLINDER COVER C.I.
No. 356
2 PISTON RINGS C.I.
No. 359
1 PISTON, C.I. No. 358
1/8 Pipe Tap
Tap for 1/8 Pipe For Exhaust
No. 28 Drill
No. 10 Drill

every amateur does not have such a chuck, it can be bored out by fastening it to the lathe face plate by four small straps and bolts, one strap to each of the four corners, next to the lathe face plate. If the latter method is used, first put the cylinder casting in the vice, and with a coarse file take off the draft on the face of the flange intended to go next to the face plate. Then mount the casting on the face plate as near the centre as possible, bring up the tail stock centre against a piece of hard wood or brass placed across the end of the casting, and screw up the centre just enough to keep the casting in place. Then place the four straps on the corners of the flange and tighten down the cylinder to the face plate. Remove the



QUARTER H. P. HORIZONTAL ENGINE.

tail stock, put a round pointed tool in the slide rest and face off the flange by taking a light, clean cut on it. After the flange is faced off true, remove from the face plate, turn around, end for end, and again fasten it to the face plate. This is done to give a flat and true surface to hold against the face plate while the boring operation is being done.

Have at hand two pieces of $\frac{1}{4}''$ × $\frac{7}{16}''$ cold rolled flat steel $2\frac{1}{2}''$ long. When replacing the cylinder on the face plate, under two of the sides, put these pieces of steel to keep the casting $\frac{1}{4}''$ away from the face plate, so that the boring tool will not cut into it at the end of the cut. Fasten down the casting with the straps and bolts temporarily. Put a tool in the slide rest and revolve the spindle of the lathe slowly with the end of the tool touching the outside wall of the casting. If it touches all around, the cylinder is in position for boring, but if not, the casting must be tapped lightly until the correct boring position is obtained. Then tightly fasten down the casting with the straps and bolts, using care to set the two steel pieces so that they will clear the finished hole, and testing with the tool to see that the position has not been changed in tightening the nuts. Set a pair of inside calipers to $1\frac{1}{2}''$, and with a boring tool in the slide rest, bore out to $1\frac{1}{2}''$. To secure a smooth and true hole, take three cuts, the last one being very light with very slow feed.

The boring operation being now completed, remove the cylinder from the face plate and drive into the $1\frac{1}{2}''$ hole just bored, a $1\frac{1}{2}''$ mandrel, and replace in the lathe between centres. Face up the cylinder to the length of $2\frac{1}{2}''$, bearing in mind that the two end flanges must be $\frac{7}{16}''$ wide.

The four sides of the castings must now be machined to $2\frac{1}{16}''$ square. There are several ways of accomplishing this operation, such as milling on a mandrel between the centre of a universal milling machine, planing, shaping, filing or turning. In this case, the turning method will be used. But before doing this turning, a gauge to turn to will have to be made. Take a piece of cast iron or steel and turn it to snugly fit the $1\frac{1}{2}''$ hole in the cylinder. Then turn up the remaining part of the material to $2\frac{1}{16}''$ in diameter. This will act as a gauge to make the circle to turn to. Rub on the flange with a rag or waste a little blue vitrol and let it dry. When dry, insert the gauge, and with a sharp scriber, follow the $2\frac{1}{16}''$ diameter of gauge, producing a $2\frac{1}{16}''$ circle true with the centre of the cylinder, which is a very important feature.

To turn off the sides, a small angle plate bolted to the face plate will have to be used. The length of the cylinder is $2\frac{1}{2}''$, $1\frac{1}{4}''$ will be half or the centre of the length. Set the angle plate shelf $1\frac{1}{4}''$ from the centre of the spindle of the lathe, and be careful to have the faces of the angle plate and the face plate square. Fasten down with the four straps and bolts the flange of the cylinder to the shelf of the angle plate, and with a round nose tool, face the first side down to the circle made on the flange. Do not cut the line, but only

just to it. Loosen the straps, turn the cylinder a quarter turn. Square the side just turned exactly by the face of the face plate, fasten and turn down as with the first side. Repeat the operation to the remaining sides, and as stated above, do not cut out the line, and be certain that the casting is square for each cut.

Having bored, faced and turned the four sides to $2\frac{1}{16}''$ square, the steam ports will claim the next attention. These not being cored in will have to be drilled and cut out with a small flat chisel and finished to size with a small flat file.

Rub on a little vitrol on the two right hand side flanges so that the lines to be made can be clearly seen. Lay the cylinder down lengthways on a surface plate, and by means of a surface gauge or scratch block, strike a line $1\frac{1}{32}''$ from the surface plate. This will give the centre of the cylinder as it is $2\frac{2}{16}''$ square. Turn the cylinder on its end and set the point of the scratch block needle to $\frac{3}{16}''$ from the top of the surface plate. This gives the centre of the steam port. Strike a line, say $\frac{13}{16}''$ long, or $\frac{13}{32}''$ each side of the line that was made when the cylinder lay lengthwise. Repeat this on the other end. Mark lightly where these lines cross with a prick-punch. Set dividers to make a $\frac{1}{8}''$ circle, and, beginning with the centre punch, lay out five $\frac{1}{8}''$ circles, one in the centre and two on each side. Set the needle of the scratch block to the top and bottom of these circles, and make a line $\frac{11}{16}''$ long for a guide to file out the ports to. Drill these five holes, first with a short $\frac{1}{16}''$ drill, using care that the drill starts in the centre of the line. Follow with a $\frac{7}{64}''$ drill.

The remaining stock left by the drill must be clipped out with a small flat chisel and finished to the lines with a small flat file. The size of the steam ports are $\frac{1}{8}''$ wide, $\frac{5}{8}''$ long on the outside, and $\frac{3}{4}''$ on the inside of the cylinder bore. To increase the inside to $\frac{3}{4}''$, file a $\frac{1}{16}''$ slant on each side, which will give the port $\frac{3}{4}''$.

# STUDIES IN ELECTRICITY

## XVI. ALTERNATING CURRENTS

In previous chapters the action of a conductor moving in a magnetic field, was considered. We also learned that a coil of wire in making one revolution in a magnetic field, generated a current in one direction during half of the revolution, and in the opposite direction during the other half revolution. In direct current dynamos, this alternation in the direction of the current in the coils is changed to a current of one direction in the main circuit by means of the commutator. If the current in one coil was transmitted directly to the main circuit, the E. M. F. generated during the different angles of the revolution would be as represented in Fig. 36. This curve assumes the revolution to begin with the coil in the position 1-2, Fig. 37, which is parallel to the magnetic field and with no current being generated. As the coil revolves to the positions 5–6, it cuts an increasing number of lines of force until it reaches the maximum at positions 3–4. Continuing to revolve, the E. M. F. deminishes at nearly the same rate with which it increased through the position 7–8 until the position 2–1 is reached when the E. M. F. is again at zero. The other half revolution produces the same increase and decrease of the E. M. F., but in the reverse direction in the coil.

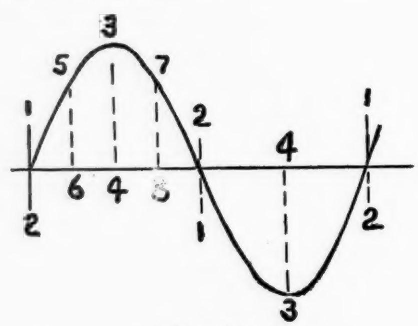


FIG. 36.

Currents which rise and fall in strength and change in direction as indicated above are known as *Alternating Currents* and one complete revolution is called a *Cycle*. One *Alternation* is that

part of a revolution during which the current rises from zero to the maximum and returns to zero. The *Frequency* is the number of cycles occuring in one second. A simple coil making 2400 revolutions per minute in a bipolar field would have 40 cycles per second or as it is commonly stated "40 cycles." Additional pairs of poles increase the number of cycles or the frequency. As a bipolar motor would have to be driven at an extremely high rate of speed to obtain a desirable number of cycles, it is customary to construct alternators with a number of pairs of poles, thus securing a moderate speed for the amature. The number of poles vary from 12 to 60 or more, and the speed is such as to generally secure between 50 and 120 cycles.

It is customary when comparing alternating currents with direct currents, to consider the *average value* of the former. We have already seen that the E. M. F. in one direction is equal to the E. M. F. in the other direction, and hence, for purposes of measurement and comparison, the

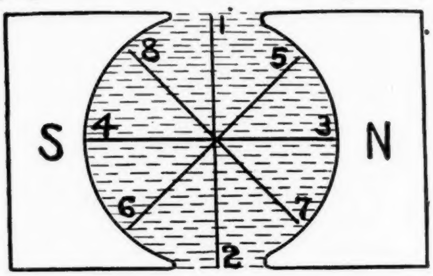



FIG. 37.

E. M. F. may be considered as constantly rising and falling in one direction. Refering to Fig. 36 showing the sine curve of the E. M. F., the average value of such a curve is .637 of its maximum value; that is, if the maximum strength was one ampere, the average would be .637 ampere. As a direct current of .637 ampere will not maintain an incandescent lamp at the same brilliancy as will an alternating current of this average strength, it is evident that more work is being done by the alternating than by a direct current. It is therefore customary to use for comparison the *Virtual* E. M. F. of an alternating current varying according to the sine law, which is equal to the maximum value divided by the square root or .707 of the maximum value. Such a current is the equivalent, as regards work performed, of a constant current of .707 ampere. But alternators do not always generate an E. M. F. exactly represented by this curve though very closely approximating it. As the maximum E. M. F. is greater than the virtual E. M. F. in an alternating current system, a higher insulation is necessary, especially with the extremely high voltage now used for conveying the current long distances.

The virtual E. M. F. is as above stated when the power is expended in any circuit, leaving no appreciable self-induction, as for example, an incandescent lamp. When the circuit contains self-induction, the current does not rise and fall simultaneously with the E. M. F., but *lags* behind it, depending on the amount of the self-induction; that is, the maximum E. M. F. and the direction of the current is not changed until after the E. M. F. has changed and is acting in the opposite direction. The interval between the opposing E. M. F. due to self-induction and the current, is known as the *Phase Difference.*

Self-induction is present to a greater or less extent in nearly all circuits, and the higher the frequency the greater the self-induction. The greater the phase difference, the less is the actual power developed in the circuit.

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A new instrument called a hydroscope has recently been invented by a Genoese engineer, which if it proves to be what is claimed for it will be of considerable value. The hydroscope, according to the report, enables one to see under water giving a clear view over an area of several thousand square yards at a depth of five or six hundred yards under water. If this instrument should prove practical in seeing under water it would be of considerable service on ship board, enabling navigators to see submerged objects, reefs, and other obstacles which are often the cause of disaster. It would also be of great assistance in locating sunken vessels, the bodies of drowned persons, and whatever else might be desirable to be seen and recovered.

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It is reported that large deposits of platinum haue been discovered in western Siberia. As this metal is largely used in manufacturing electrical appliances the discovery is an important one.

# PORCUPINE BOILER FOR HEATING HOUSES

WILLIAM F. FRANCIS.

## III. BOILER FITTINGS.

Steam is maintained at a constant pressure by regulating the amount of air admitted below the grate, and if this fails to check the rise in pressure, the fire is checked and the boiler is cooled by opening the fire door. While this latter method may not be good practice on the tubular boiler, this boiler does not appear to be affected in any way by it. These two operations are performed automatically by means of the diaphragm shown in Fig. 6. Although the whole apparatus is called a diaphragm, the diaphragm proper is shown at *a*, Fig. 6, which is merely a piece of $\frac{1}{8}''$ or $\frac{3}{16}''$ rubber insertion (pure gum without any cloth in it), which is cut the same size as the outside of the cast iron flanges *j*, and no holes through it except the bolt holes. The water enters through the $\frac{1}{2}''$ pipe tap hole beneath the diaphragm and forces up the rubber diaphragm, carrying the mushroom shaped piece *c*, with it, thus working the lever *d*. The diameter of *c* should be rounded at the lower corner so as not to cut through the rubber. The $\frac{3}{4}''$ spindle on which the lever rests, should be knife-edged where the lever rests on it, also be about $\frac{1}{16}''$ loose in c, and also be pointed at the lower end.

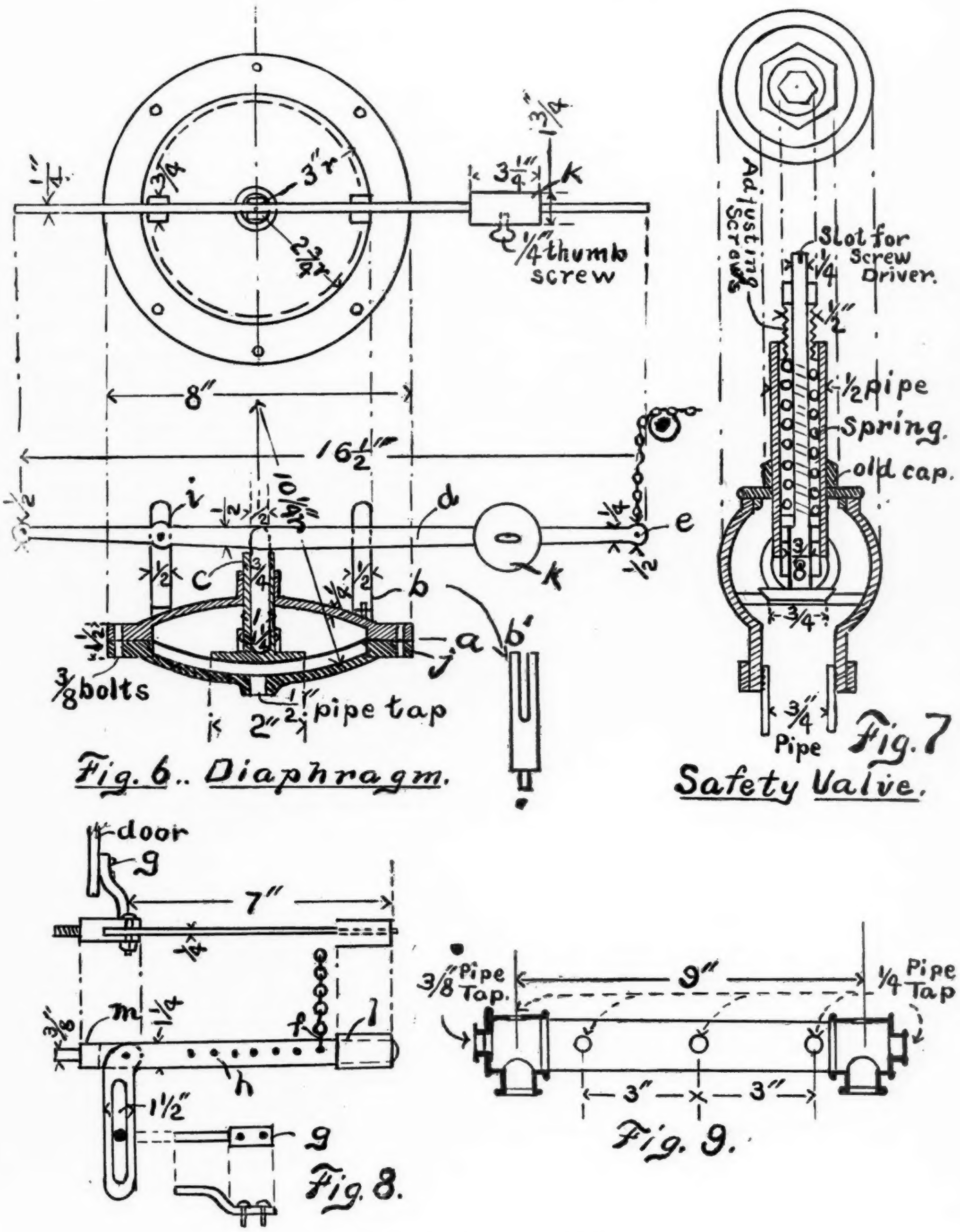
A light chain is run over a pully from *c*, thence to another pulley which brings it in line with the flap on the lower door shown in the front elevation of the boiler setting. This regulates the draft through the grate. A chain is also run from *e*, Fig. 6 to *f*, Fig. 8. This chain is left loose, so that the ash pan door closes first, then if the diaphragm goes further this chain tightens and pulls on lever *h*, opening the fire door. Piece *g*, is fastened on the furnace door, which has no latch on it but is held closed by weight *l* (*l* is a pipe coupling into which lead has been poured, thus making a weight); *h* and *m* are brass castings, *m* being screwed into the door frame (or furnace front). By making a pattern for the top plate of the diaphragm with two bosses to receive piece *b*, which guide the lever, and leaving the part at *c* uncored, the same patern will do for both top and bottom. The piece *b*, can then be made of cast iron or forged as shown at *b*. The $\frac{1}{2}''$ pipe from the bottom flange should be connected to the lowest part of the boiler; a tee just before the blow off cock will do.

A safety valve may be made out of an old $\frac{3}{4}''$ angle valve as shown at Fig. 7. The seat should be at 45°. The valve and spindle are turned in one piece out of a piece of brass rod. The sleeve which holds the spring may be made of pipe and screwed through the old cap as shown, by using fine threads or screwed on the old threads which held the gland. The valve spindle should fit loosely so that the valve may find its own bearing.

The water column may be made out of tees and pipe as shown at Fig. 9, or a combination of nipples and tees may be used. The try-cocks may be common bib-cocks. The water-glass fittings may be made out of angle valves by boring out the thread of the outlet and turning the squares off and threading, making glands out of brass rod. The water column may be longer than shown. I have one the whole length of the boiler.

A check valve should be placed near the boiler on the return pipe from the radiators. The safety valve may be placed on the outlet (steam pipe to heaters), taking care there is no valve between the safety valve and the boiler. There should be no valve between the water column and the boilers. A $\frac{3}{8}''$ valve should be placed at the bottom of the water column for blowing it out. A connection with the water pipes should be made for filling the boiler. There should be a small valve or pet-cock in the bottom fitting of the water-glass to blow that out. In running the piping to radiators a horizontal pipe should have a pitch from the boiler and the further end of such a pipe should be connected to the return pipe with a $\frac{1}{8}''$ pipe connection.

Any questions which may be asked regarding this boiler will be answered in the correspondence column of this magazine.




PORCUPINE BOILER.

# AMATEUR WORK

**63 KILBY ST., BOSTON**

DRAPER PUBLISHING CO., PUBLISHERS.

**A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.**

***Subscription Rates for the United States, Canada and Mexico, $1.00 per year. Single copies of any number in current volume, 10 cents.***

**TO ADVERTISERS.**

**New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.**

Entered at the Post-office, Boston, as second-class mail matter Jan. 14, 1902.

FEBRUARY, 1903.


## GRAND PRIZE FOR SUBSCRIPTIONS

As a special inducement for those who are in a position to secure a large number of subscribers for this magazine, arrangements are being made with a well known excursion agency, for a trip to the World's Fair at St. Louis in 1904. This will include all expenses enroute, and for five or six days at the Fair, and will be offerd, *in addition to the other premiums*, to the person securing the largest number of subscriptions before June 1st, 1904. Full particulars will be announced as soon as the excursion agency has completed its arrangements. This preliminary announcement is made to enable our readers to consider the matter and formulate plans for working for it. Other prizes of a screw cutting lathe, tools, etc, will be added, so that anyone who may not obtain the first prize will still get a reward well worth the having. As a suggestion, the pupils of a large manual training school could work together and secure this trip for an instructor, as this fair will be one which all instructors will greatly wish to visit. The locality will make no difference in awarding the first prize, whether it be Sidney, C. B. or San Francisco, Cal. Begin at once and so get as many interested as possible, remembering that you may secure the regular premiums for subscriptions as they are sent in.

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The March number of this magazine will contain the first chapter of a complete description of "How to Build an Automobile." The design will be in accord with the current practice, which experience has shown to be desirable. It will be a gasoline machine, supported upon an iron frame without reaches. The body will have a removable tonneau providing seating capacity for two or four persons as desired. Any mechanic with a proper tool equipment at his command can build a very satisfactory machine from these directions. We feel confident that many of our readers will find these articles of great interest even if they do not construct a machine therefrom.

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An advance premium list is now ready and will be mailed upon receipt of request from anyone desiring it. This list is a temporary one designed to serve until many new articles, now being investigated can be added thereto. It is intended that only well made and durable articles shall be offered, and the work of investigating requires much time. The present list contains many tools and instruments which amateur or professional will find useful and we think our readers will be able to make a satisfactory selection whenever they secure a subscription.

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Treatment by Roentgen rays is proving of importance in cancer of the skin. Reporting four recent cures Dr. Gilchrist reported having seen in Manchester thirty-four cases that had been completely cured, while Finsen has reported forty-five cured cases. The application usually lasts fifteen minutes, though it may extend to thirty minutes. The malignant cells seem to be especially sought out by the rays, but burns may occur, and for preventing them a special glass tube—opaque except at the ends—has been devised.

# WOOD TURNING FOR AMATEURS.

F. W. PUTNAM, Instructor Manual Training School, Lowell, Mass.

## V. THE RECESSED CYLINDER.

For this exercise we will require a pine block 2″ × 2″ × 8″ in length. First turn the block down to the required diameter, 1¾″, and mark off the necessary divisions, as shown in Fig. 38. The block is 1″ longer than the finished exercise, in order to allow ½″ at each end for removing the centre marks, this being done by the parting tool after the exercise has been completed.

At points *A* and *B*, Fig. 39, cut in with the parting tool down to a diameter of 1⅛″. With the 1″ or 1½″ skew chisel, start a cut from *C*, continuing it downward, toward the left, the dotted line, 1, representing this cut. Next, start from *D* and continue the cut downward toward the right, as shown by the dotted line, 7, meeting the first cut. As the cut is carried downward, the handle of the chisel must be slightly raised, and the cutting edge forced deeper into the wood. This forcing of the cutting edge into the wood must be small during any cut, and the necessary depth must be obtained by a series of cuts, as shown by the dotted lines 1, 2, 3, 4, 5, and 6, of Fig. 39. The third or fourth cuts should reduce the cones to the bottom of the groove cut by the parting tool. When this point has been reached, test the surface of the cones with a rule or scale to see if they are straight. Any high places should be marked and carefully removed with the skew chisel.

Next find the centre of the groove made by the parting tool, and at this point cut in $\frac{1}{16}$″ with the acute angle of a ⅜″ skew chisel. Cut down on both sides to this centre line. These last cuts should leave the diameter at the bottom of the groove but slightly larger than the required $\frac{1}{16}$″. One more very light cut on both sides should be taken, so as to make the sides perfectly straight. Before doing this, however, the bottom of the groove had better be marked with a pencil line, so that, when the final cut is taken, there will be no chance for this line, which is at the bottom of the groove to be moved either to the right or left of the centre. The second set of conical surface is made in the same manner. When turning the second set of cones, great care should be taken not to cut beyond the line *D*, which is the dividing line between the two sets of cones. When cutting next to the line *D*, in either direction, or at *C* and *D*, the obtuse angle should always be used for the cutting point.

The tee rest should be kept fairly high, especially where the final cut is to be taken. Fig. 40 shows the positions of the hands in cutting down toward the right. The cutting may be done between the obtuse angle and the acute angle, or "between corners," as it is often called, or at the obtuse angle. In either case the acute angle must be kept clear of the work. The chisel must be held flat enough so that the under bevel, which must be ground perfectly flat, shall bear upon the surface being cut, otherwise considerable difficulty will be found in keeping the sides perfectly straight. If the skew chisel be kept sharp, and care is taken not to force the cutting edge too deep into the wood, one should have little difficulty in turning his exercise satisfactorily.

This exercise is designated to give additional practice in the use of the large skew chisels. The gouge might have been used to start the conical surfaces, in which case, the tee rest may be placed parallel to the surface to be cut.

A combined cylinder and cone exercise, shown in Fig. 41, is given as an extra or supplementary, in case the amateur desires more practice with the large skew chisels. The middle set of cones should be turned first. When the surface at *A*, which is at an angle of 60° to the horizontal, is turned, be sure that the cutting is done with the obtuse angle, and that the handle of the skew chisel is raised sufficiently.

### FOURTH EXERCISE:—BEADS.

For this exercise a pine block, 2″ × 2″ × 8½″ in length, will be required. First, turn the block

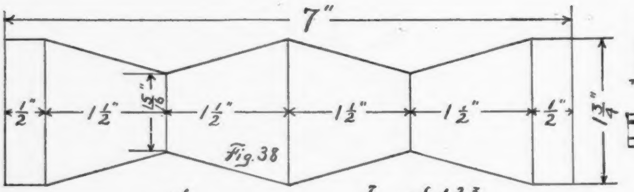

Fig. 38

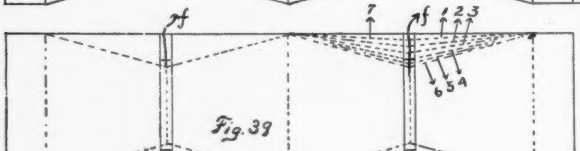

Fig. 39

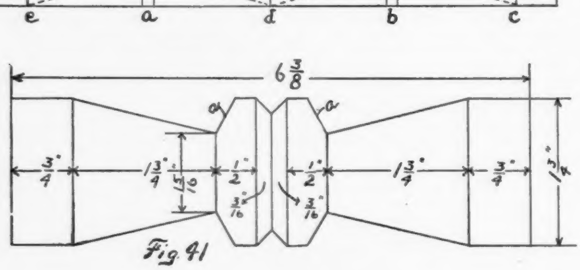

Fig. 41

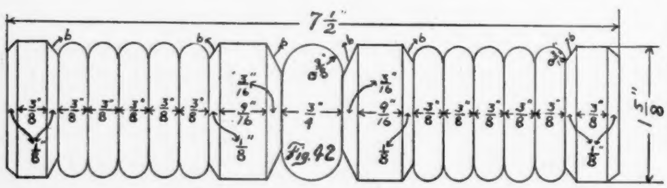

Fig. 42

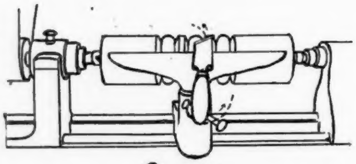

Fig. 44

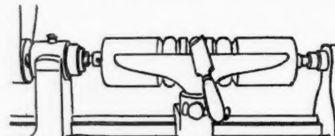

Fig. 45

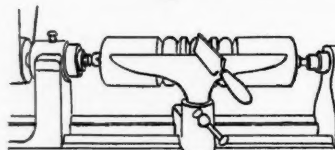

Fig. 46

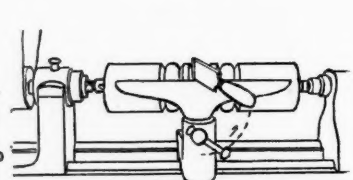

Fig. 47

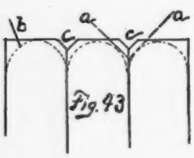

Fig. 43

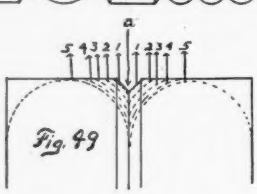

Fig. 49

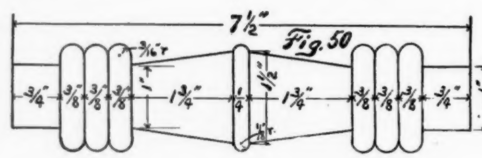

Fig. 50

down to the required diameter, $1\frac{5}{8}''$, and mark off the necessary divisions, as shown in Fig. 42. Cut V shaped grooves at the divisions marked, c, Fig. 43, with the acute angle of the $\frac{3}{8}''$ skew chisel. Do not cut the grooves too deep, or too far back toward the top of the bead, as shown at a, Fig. 43. If this is done, the beads, when finished, will not be semi-circular in shape, but peaked, as shown at d.

The convex curves forming the beads are to be cut with the $\frac{3}{8}''$ skew chisel, the obtuse angle being used. Fasten the tee rest within $\frac{1}{4}''$ of the block and place the chisel with the shaft at right angles to the axis of rotation. Start the curve at the top of the bead, and pass the chisel from the positions shown in Fig. 44, through the positions shown in Fig. 45 and Fig. 46, to that for cutting a groove, shown in Fig. 47. The handle must be swung round with a twisting motion of the right wrist, and also raised somewhat, depending on the size of the bead. In Fig. 48 is shown the position of the hands in turning the beads. It will be noticed that the first finger of the right hand is placed along the shaft of the skew chisel.

This will aid in guiding the tool. There must be no hurrying in the swinging round and raising of the tool handle. The whole movement must be smooth and even. A beginner will, at first, be likely to hurry the latter part of the movement unless care is taken to prevent it. The cutting must be done at the obtuse angle. Figs. 44 to 47 show the movement of the chisel in cutting the left half of the bead. Generally the beginner experiences less difficulty in turning this half than the half at the right. When cutting the right half of the curve, the movements are the same as have just been described, except that the motion is now from left to right instead of from right to left.

With a little practice the amateur should be able to get a close approximation to the half circle with one cut in each directions. Generally it will be found an advantage to approximate all the beads before finally finishing any one of them. Oftentimes a bead will look too flat. If but little stock needs to be removed to remedy this, place the tee rest quite high on the work, and hold the skew chisel so that as much of the under bevel of the tool as possible may bear on the work.

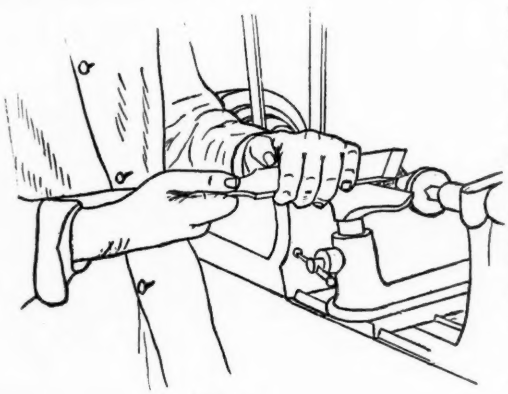

Fig. 40.

The centre bead is to be turned last. This bead is much larger than the others, and the grooves at either side are much deeper. Several cuts should be taken in turning this bead, the first cuts being started near the groove a, Fig. 49. All the grooves b, Fig. 42, are to be cut with the acute angle of the $\frac{3}{8}''$ skew chisel. They must be perfectly straight, using care to keep the obtuse angle clear of the work. For turning beads and all other convex curves the skew chisel must be carefully ground, with a perfectly straight cutting edge and a straight flat bevel. Without this the chisel cannot be guided and supported properly.

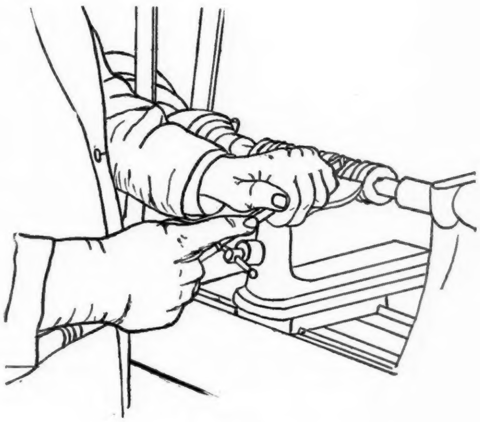

Fig. 48.

There is another method often used in starting a bead. The skew chisel, instead of being held at right angles to the axis of rotation, is held in the position used for smoothing a cylinder, the angle between the shaft and the axis of rotation being considerably greater than 90°. In this method the handle is raised through a much greater angle than in the method first described. This method will be found to be rather more difficult, especially in the turning of beads from hard woods, owing to the greater tendency for the cutting edge back of the obtuse anlge to come into contact with the wood, thus catching into and tearing the surface.

The form shown in Fig. 50, may be used as an extra, and is a combination of beads, cones, and cylinders. This exercise combines the principles taken up in the first four regular exercises.

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Marconi, of wireless telegraphy fame, is reported to have discovered a method by which oxygen may be extracted from air at a very slight expense. Like many other useful discoveries, this was made by accident while Marconi was engaged in perfecting another and widely different idea.

# PROJECTION

Carl H. Clark

## V. POLYGONS

In order to more clearly understand the projection of the more complex solids, it is necessary to consider briefly the principles governing the projection of plane polygons. Take for example a hexagon as in Fig. 17.

Let *A*, *B*, *C*, *D*, *E*, *F*, represent the hexagon when lying flat on the horizontal plane with its axis parallel to the vertical plane; the vertical projection is of course merely a straight line *a-n*, whose length is equal to the greatest width of the figure.

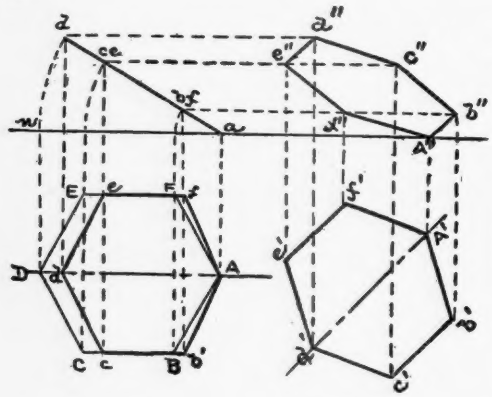

Fig. 17. Eig. 18,

Suppose now that it is desired to draw the plan of this figure when one end of it is raised so that the axis makes an angle of 30° with the horizontal plane, the point *A*, remaining fixed and the figure revolving about it. Through the point "*a*", draw a line "*a-d*", making an angle of 30° with the line of intersection. Since the figure may be considered to revolve about the point *A*, the other points *b*, *c*, *d*, *e*, *f*, will travel in circles with *A* as a centre, and if from the points *B*, *C*, *D*, *E*, *F*, verticals are drawn to the line of intersection and arcs struck with *A* as a centre, to cut the axis already drawn, the position of the points in their revolved position are obtained and this inclined line is the elevation desired.

To obtain the corresponding plan it is only necessary to notice that points in the plan move in straight lines parallel to the vertical plane, so that if through each point such a line is drawn, and the points in the elevation are projected down on to the proper one, the points *b*, *c*, *d*, *e*, *f* on the plan are obtained, and all that is necessary is to connect them by straight lines and the plan view is obtained.

Fig. 18 shows the same hexagon with its axis making the same angle as before with the horizontal plane, and also with the plane of its axis at an angle of 45° with the vertical plane, instead of parallel to it. The plan *A'*, *b'*, *c'*, *d'*, *e'*, *f'* is the same as *A*, *b*, *c*, *d*, *e*, *f*, with its axis making the angle of 45°. It is to be noted that, as the figure is swung into its new position the height of all points in the elevation does not change, and consequently this elevation still shows the true height. If through each point a horizontal line is drawn and this line is cut with a projecting line from the corresponding point on the plan, the new location of the points is obtained and the elevation completed. For this construction a hexagon of about 2″ across the corners is recommended. In this construction, and also in what follows, the projecting and construction lines have been allowed to appear in order to make it as plain as possible, but in the actual work on the drawing board the larger part of them would better be left out.

To draw the various projections of a hexagonal prism. A prism may be taken 4″ high with the base 2″ across the corners. Let *A*, *B*, *C*, *D*, *E*, *F*, be the plan and the figure "*a*" directly above be the elevation of the prism when one of its faces is parallel to the vertical plane. The upper end of the axis is shown at *X* in the plan, and its position in the elevation is *X*,′*X*′, Fig. 19. Remembering that the ends of a right prism are equal and similar figures parallel to each other, and united by lines perpendicular to their surface, it is evident that

projecting a prism is only repeating the process of projecting a plane.

To obtain its projection, Fig. 20, when inclined until its axis is 30° from the horizontal and parallel to the vertical plane. Draw a line to represent the axis at the 30° angle and on this line reconstruct the elevation of Fig. 3, the lower corner resting on the line of intersection, obtain the plan view corresponding by dropping perpendiculars from the points in the elevation and intersecting these by horizontal lines from the corresponding points in the plan of Fig. 3. Connect the proper points by straight lines and the plan will appear as Fig. 4.

the projection of the solid on a plane perpendicular to the other two as *YY*, and in the same manner as the vertical plane may be conceived to be folded back through an angle of 90°, so this auxiliary plane, as it is called, may also be considered to be folded back through a horizontal angle of 90° into the plane of the paper. This accounts for the 90° arcs shown in obtaining Fig. "*b*".

The use of more than two views has not before been necessary, as in drawing a cube or the table before shown, both side views are the same; but in objects of any degree of complication at least three views are necessary.

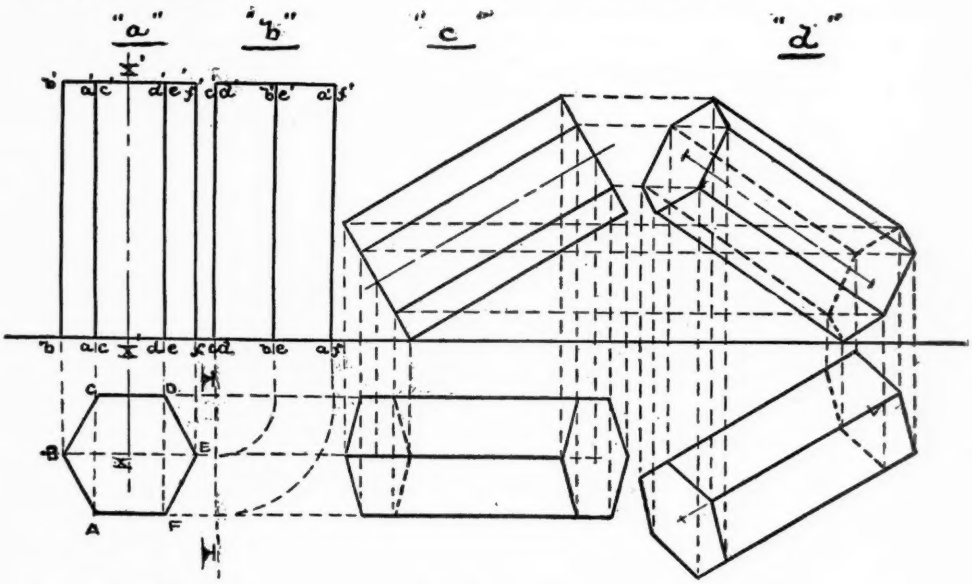


FIG. 19. FIG. 20. FIG. 21,

Fig. 21, shows the prism with the axis at 30° to the vertical plane and 30° to the horizontal plane. The plan is a duplicate of that of Fig. 4 with its axis turned to an angle of 30° with the vertical plane; the elevation is drawn by carrying up perpendiculars from the angles and intersecting them by horizontals through the corresponding points in the elevation "*c*", and connecting the points by straight lines.

The elevation "*b*," has not yet been explained. This is the side view looking toward one edge, or in the direction *E*, *B*, parallel to both vertical and horizontal planes; or in other words, it is

A good subject for further practice in this line will be a prism 3″ high, having for its bases a pentagon 2″ across the corners.

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There is no reliable method of p reserving rubber except by keeping it in a damp place, and away from the air as much as possible. Exposure to the air and dry atmosphere will perish the best of rubber in time. Oil of any kind is a dea dly enemy to rubber.

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Remembr to renew your subscription promptly so that you will have the complete volume.

# SMALL STORAGE BATTERIES

Harry Mortimer Specht

There is nothing more pleasing and interesting to the amateur than to make a storage cell and have it work successfully. I shall endeavor to be as explicit as possible in this description and if it is carefully followed, a cell equally as good as any purchased battery may be constructed.

Only a few tools are necessary in the work, the principal ones being a mallet, a broad chisel, a rose countersink, a $\frac{1}{4}''$ drill and bit brace.

To proceed with the work; first a strip of lead $9''$ x $16''$ by $\frac{1}{4}''$ thick is procured from any plumber's supply store. If the sheet lead cannot easily be obtained a wooden mould can be made of the exact shape of plates and cast, using care to get

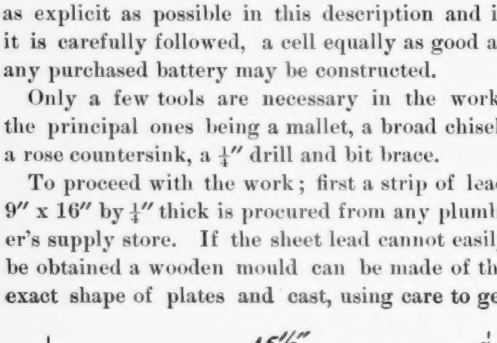


Fig. 1

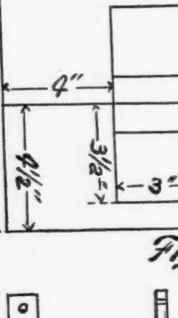

Fig. 2

Fig. 3

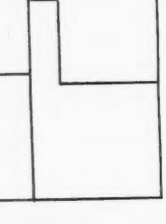

Fig. 4

pure lead for same. The lead sheet is laid on a flat surface and nicely straightened out by hitting it gently with the mallet. To facilitate the work it is a good plan to make a pattern of a plate out of thin wood or card-board. The plate or grid as it is sometimes called, should be $4''$ x $4\frac{1}{2}''$ with a stem or connection $3''$ long and $1''$ wide. This stem or lug will be subsequently spoken of. Fig. 1 illustrates the shape of grid. Now take your pattern and place it on the sheet of lead, holding it securely with one hand. Then go around the edges with some sharp pointed tool to outline shape of plate. You must use care in placing the pattern on the lead as shown in Fig. 1, in order that none be wasted and that you get the five plates intended for the complete battery. After having completed this work of marking out the plates, cut them out carfully with the chisel. A blade from an old plane might be used to better advantage than the chisel as it takes longer cuts. Having cut out the five plates they should be flattened nicely and the edges filed smooth. Care should be taken to have the plates uniform and even in all respects.

This type of storage cell is known as the French Type. The active material is put in the grids in the form of a paste. To hold this material, sixteen $\frac{1}{4}''$ holes equal distances apart are now drilled in each plate. Holes may be made with a drill press, or if one is not handy, an ordinary breast drill or brace may be used. Each hole is then reamed out or countersunk an equal distance on both sides, making same conical in shape. This is to hold the paste firmly. When this operation is completed the plates will appear as shown in Fig. 2.

Our grids are now ready for the insertion of the active material. Three of the five grids are to be used as negative and the remaining two as positive. It is deemed advisable to have more negative surface than positive, as this prevents buckling to a great extent and gives the cell greater efficiency.

The next and a very important work is to paste the plates. For this work use red and yellow lead,—the latter is better known as litharge. One half pound of each will be ample. A paste of about the consistancy of damp sand is made from the yellow lead, being mixed with a solution of sulphuric acid and water; the proportions being 1 part of acid to 10 parts of water. Care must be taken to pour the acid into the water and

not the reverse. A great mistake will be made if too much liquid is added to the litharge. Just enough should be mixed to hold the material together. Three of the grids are chosen and the holes solidly filled with the litharge. An easy way of doing this is to lay the grids on a flat surface, a board or preferably a piece of marble or slate. The material may be pressed into the holes with the fingers and afterward pounded in with a hammer and then made smooth. In a similar manner the remaining two positive grids are filled with the red lead and acid solution. When the grids are all pasted they are kept in a dry place for at least 24 hours, care being taken not to jar or disturb them. When thoroughly dry the five plates are totally emersed in a solution of sulphuric acid and water, 1 to 10, and left there for a day or so. Probably while in this solution some of the material will become loosened or fall out of the holes, but this must not be remedied until the remaining paste becomes hard and can be scratched with the finger nail. Then the holes that are empty may be filled and allowed to harden as before mentioned.

The elements are now ready to be set up in the form of a battery. Very good insulators may be made by cutting a hard rubber tube in short lengths or rings and running them on a hard rubber rod. Figs. 3 and 4 illustrate the hard rubber rod, insulator, and arrangement.

In order to have the elements appear neatly, I would suggest getting ½″ hard rubber tube with extra heavy walls and a hard rubber rod to fit tightly in the aperture. The best way to cut the rings from the tube is with a hack-saw. Sixteen ¼″ insulators should be cut for this set of elements. Four small notches should be made with a round file in the same place in each plate; thus forming a recess for the insulator rod and tend to hold it in place.

It is quite essential to have the plates arranged alternately positive and negative. This would place negative grids on the outer side.

To form the two poles of the battery, the positive and negative plates have to be joined separately, the stems of each kind being placed on opposite sides. Let us connect the three negative plates first. To do this nicely, two short pieces of ordinary gas pipe are placed between the stems, and then these stems are bent together with a clamp. In a similar manner the two positive plates are joined. To make a good electrical connection the tops of the stems are soldered together. Binding posts may be used for terminals. It is a good thing to paint or parafine these terminals to prevent corroding by the fumes that come off during the charging.

Our battery is now ready for forming. This is a chemical action which is performed in order to make the cell retain its charge. A battery which has not been properly formed, will quickly lose its current. The quickest method to form the the plates is to place the elements in a concentrated solution of chloride of lime for several hours. They should then be taken out and thoroughly washed and dried.

A good electrolyte to use is made from sulphuric acid and water, proportions one to eight. The cell may be charged from any direct current circuit in series with a 16 c. p. lamp, by a small dynamo or four large cells of gravity battery connected in series. In joining cells for charging it must always be remembered that the positive pole of the charging circuit be joined with the positive pole of the storage battery.

Two of these batteries make an excellent electric light outfit. When fully charged they will supply current for a one c. p. lamp for 12 hours or more.

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An order from the Japanese government for a number of X-ray machines has been received by a firm in Philadelphia, says Electricity. A representative of the Mikado recently purchased an X-ray machine here, which, he explained, was to be used in the government mints in Japan for the detection of dishonest employes, who practised the trick of swallowing gold coins and carrying them away. The machine was used to examine suspects as they left the mint daily, and it revealed the presence of coins that had been consigned for safe keeping to the guilty ones' stomachs. The test was so satisfactory that the Mikado has ordered several machines, and with their aid hopes to prevent further thefts.

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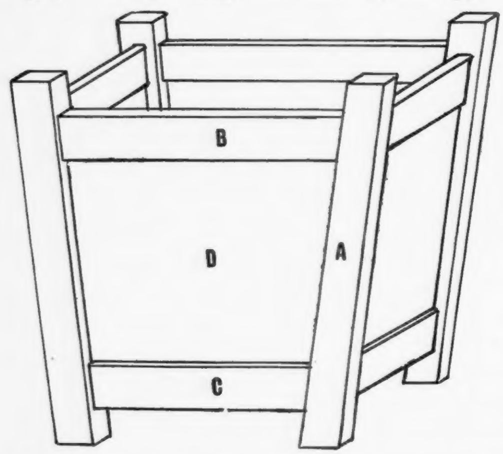
A system of automatically lighting the street lights from a central point by electricity, is now being tried in Berlin.

# A WASTE BASKET

John F. Adams

While the design for this box or basket is quite plain, yet it will be found to be rather attractive. If the maker can add a little fret sawing or carving to the panels, the appearance will be much enhanced. Oak is the best wood to use, to secure the effect of the grain.

The corner pieces *A*, are $15''$ long and $1\frac{1}{4}''$ square. The top cross pieces *B*, are $2\frac{1}{2}''$ wide, $\frac{7}{8}''$ thick and $10\frac{1}{2}''$ long on the upper or longer side, allowing $\frac{1}{2}''$ on each end for tenons; the ends being cut at a bevel as shown in the illustration. The mortises in the corner pieces *A*, are $1\frac{1}{2}''$ long, $\frac{1}{2}''$ wide $\frac{1}{2}''$ deep, and centered, the upper




end of the mortises being $1\frac{1}{2}''$ from the upper ends of the pieces. The lower cross pieces *C*, are also $2\frac{1}{2}''$ wide, $\frac{7}{8}''$ thick and $7\frac{1}{2}''$ long on the lower or shorter side, allowing $\frac{1}{2}''$ on each end for tenons. The mortises in the pieces *A*, are the same in size as for the upper pieces, and the lower ends are $1\frac{1}{2}''$ from the floor. If the panels *D*, are made of wood, the inner edges of both top and bottom cross pieces should have $\frac{1}{4}''$ rabbet cut out to receive the panels which should be of oak, $\frac{1}{4}''$ thick and well fitted. This gives the inside a smooth surface with no corners to catch and hold dirt. It will also be necessary to run grooves $\frac{1}{4}''$ wide and deep in the corner pieces *A*, to receive the sides of the panels. These grooves can be marked and cut after the cross pieces are fitted. The panels are $8\frac{1}{2}''$ high, about $9\frac{1}{4}''$ wide at the top and $7\frac{5}{8}''$ wide at the bottom. An initial or other plain figure could be cut in the centre and add to the effect.

The panels can also be made of leather, attached with ornamental nails on the outside of the framework. In this case, instead of making grooves in the pieces *A*, strips of wood $\frac{1}{2}''$ square are fastened with screws to give a fastening for the sides of the panels. The tops and bottoms are nailed directly to the outside of the cross-pieces, with a lap of about $\frac{1}{2}''$. Another way of making the panels is to cover binders-board with leatherette and nail with ornamental nails. The bottom of the box is a piece of $\frac{7}{8}''$ board $7\frac{5}{8}''$ square slightly beveled to fit flush with lower edges of the cross pieces *C*; the corners being cut out for the pieces *A*, and fastened with glue and nails.

When the fitting is completed, the joints should be glued when finally putting together.

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The chief engineer of the New York city underground and rapid transit system is authority for the statement that cars will be running through this great tunnel in June or July of the present year. In this connection it may be interesting to learn that the new underground system between Boston and East Boston, under the harbor, will probably be completed before the close of the year, and in connection with the elevated and subway system which has been in operation for some time, will materially assist in giving Boston a splendid system of rapid transit.

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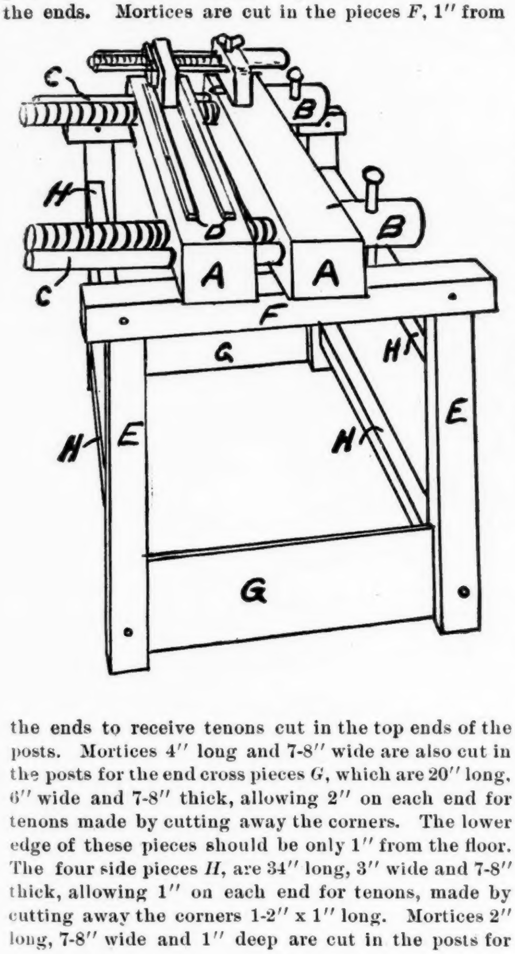
A cement for pipe joints that is said to be as good in a faced or rough flange joint as red-lead putty, at one-tenth the cost, consists of a mixture of ordinary pine tar and dry oxide of iron. At a recent meeting in Columbus of the Ohio Gaslight Association, its use was recommended by Mr George Light, who stated that it does not harden as soon as red-lead, and is very adhesive under pressure.

# BOOKBINDING AT HOME

## III. CUTTING PRESS AND PLOW

For trimming the edges of books a cutting press and plow will be required. The cutting press is also made use of as a "laying" press, the several uses of these tools being more fully described when the work of binding is reached. A heavy wooden frame is also needed upon which these tools are placed when in use. Spruce or Georgia pine are the woods most easily obtained for making the frame. Maple or birch will be most suitable for the press and plow.

For the frame obtain four pieces 2″ x 3″ x 30″ long for the posts *E*, and two pieces 24″ long for the top pieces *F*. These are framed up with the 3″ sides at the ends. Mortices are cut in the pieces *F*, 1″ from



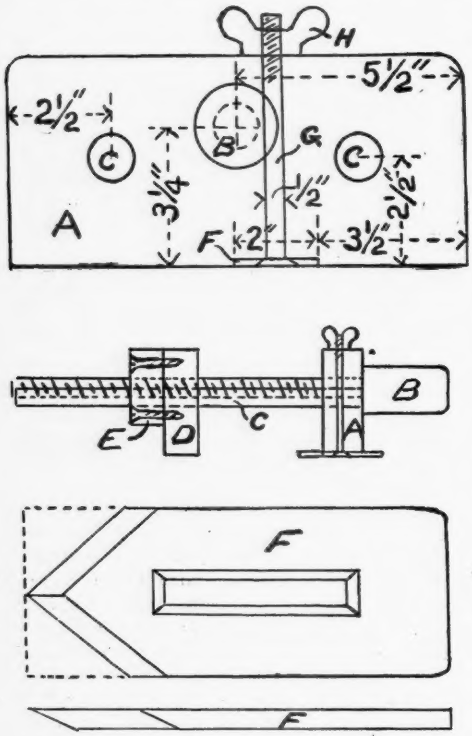

the ends to receive tenons cut in the top ends of the posts. Mortices 4″ long and 7-8″ wide are also cut in the posts for the end cross pieces *G*, which are 20″ long, 6″ wide and 7-8″ thick, allowing 2″ on each end for tenons made by cutting away the corners. The lower edge of these pieces should be only 1″ from the floor. The four side pieces *H*, are 34″ long, 3″ wide and 7-8″ thick, allowing 1″ on each end for tenons, made by cutting away the corners 1-2″ x 1″ long. Mortices 2″ long, 7-8″ wide and 1″ deep are cut in the posts for receiving the tenons on the side pieces; those for the lower ones being 4″ from the floor, and for the upper ones 22″ from the floor. All mortices are centered, and the joints set up with glue and dowel pins, as the frame must be quite rigid to withstand the heavy work required of it. A shallow box which will just fit inside the frame and rest on the lower side pieces *H*, will be serviceable for catching the trimmings from the plow. Cleats should be put on the under side of the box to hold it in place and finger holes bored in the ends for carrying about.

The cutting press rests on the frame, one side being uppermost when used as a laying press and the other when cutting. The jaws *A*, are made of two clear, well planed pieces of maple 4″ x 5″ x 40″ long, and are fitted at each end with wooden bench screws *B*. These can be obtained at small cost of any large hardware dealer and come about 24″ long and varying diameters; the 1 1-2″ diameter being strong enough. At one end is a wooden handle for turning, and at the other a small threaded block. This block must be fitted into a recess cut in the piece *A*, which serves as the rear jaw of the press, and must be firmly fastened in place with long screws. To avoid splitting the block, bore holes for the screws. The holes bored in the jaws for the screws should be large enough to freely admit the unthreaded portion of the screws and yet not be too loose, and care must be taken to see that they are bored in line. It will be evident to the reader that in turning these screws the jaws can be opened or firmly closed as desired, care being taken to turn the screws together to avoid binding. The centre of the screws should be 7 1-2″ from each end of the jaws.

The pieces, *C* are of round oak 1″ in diameter and as long as the bench screws, not including the shoulder. Holes are bored in the front jaws to tightly receive these pieces to which they are fastened with glue and dowel pins. The holes in the rear jaw are bored slightly larger to allow the pieces to move freely. Great care must be used to bore these holes in line, as the pieces serve to keep the jaws square and would bind if not put in true. Curtain poles may be used for these pieces or hickory dowel pins, as may be most conveniently obtained. On the top of the rear jaw, two pieces of selected maple or birch *D*, 5-8″ x 3-4″ x 36″ long are firmly screwed, forming a channel for one cheek of the plow. The fastening of one of these strips had best be done after the plow is made so that they may be spaced just far enough apart to allow the plow to move freely but without side play.

The plow requires two pieces of maple or birch, 11″ long, 5″ wide and 2″ thick for the cheeks. These

are controlled by a screw *B*, and two guides *C*, as shown in Fig. 4. A wooden screw can be obtained by




purchasing a large wooden hand screw, one with a screw 1″ in diameter and 18″ or 20″ long. By sawing off one of the jaws a threaded block *E*, will be obtained very similar to the one on the bench screw. Holes are bored in the cheeks of the plow to admit the screw as shown in Fig. 4. On the rear side of the rear cheek fasten the threaded block *E*, with four screws, first boring holes in the block to prevent splitting. The guides *C*, Fig. 4, are put in exactly as in the press. On the under side of the front cheek make a narrow slot for the knife *F*. This slot must be carefully made to exactly fit the knife, so that the latter will be held rigidly in place when the nut *H*, on the bolt *G*, is screwed up.

The knife is bevelled to a sharp point with quite a wide bevel and has a long beveled slot for fastening and adjusting. Probably the easiest way to provide the knife will be to order of a hardware dealer, a plane-blade. The blade of the Stanley rabbet plane will answer. Any hardware dealer can order one from the manufacturers at a cost of about 25 cents. If this blade is used to make the knife it will be necessary to have the point beveled, and also the slot, on an emery wheel, which can be done at any machine shop. At the same time a bolt *G*, 6″ long and 1-4″ or 5-16″ diameter must be obtained, and the under side of the head beveled to fit the slot in the knife. A thumb nut *H*, is fitted to the other end of the bolt, a washer being placed between it and the wood to prevent wear. If the bevels on knife and bolthead are well made, the knife will be firmly held in position. Be sure that the point of the knife is on the under side, and also the bevel in the slot.

When in use the plough is pushed backward and forward on the cutting press, which holds the book being trimmed; the left cleek being guided by the cleats *D*, Fig. 3, and the right gradually approaching the left as the screw *B*, is turned by the worker, whose hands rest on the ends of the screw. The knife must be kept perfectly sharp to prevent tearing.

# ACETYLENE

## II. TYPES OF GENERATORS

The method for bringing carbide and water together may be grouped into two general classes, viz: "water to carbide" and "carbide to water." In the first class may be placed those machines in which the carbide is dropped from a holder into the water or the holder containing the carbide is lowered into the water. In the second class the consumption of gas allows the water to rise to the carbide, and the accumulation of gas causes it to recede, stopping further generation. In this class may also be placed those generators which jet or spray water upon carbide, such as bicycle and automobile lanterns, larger machine of this latter type having practically gone out cf use.

The various machines of the two classes, differ so in construction that only by an examination of any particular machine can its merits be passed upon. As it is the purpose of these articles to give only general information of acetylene, the machines selected for illustration are not to be taken as the only good machines on the market, but simply as illustrations of the workings of machines of the two types.

Whatever type is used. every generator must have sufficient holder capacity to provide for generation in excess of that being used, as well as what may be termed the "after generation," which is the generation following the turning out of all lights. It is customary, therefore to have a small holder form a part of the apparatus, which is, with all machines acceptable to the insurance authorities, automatic in action with small plants. By this is meant that, aside from the care of clearing and charging, machines for small

plants provide automatically for generating gas as it is consumed atthe burners and the stopping of generation when consumption ceases. Large plants for villages, factories, etc., are usually of a size where attendance is necessary.

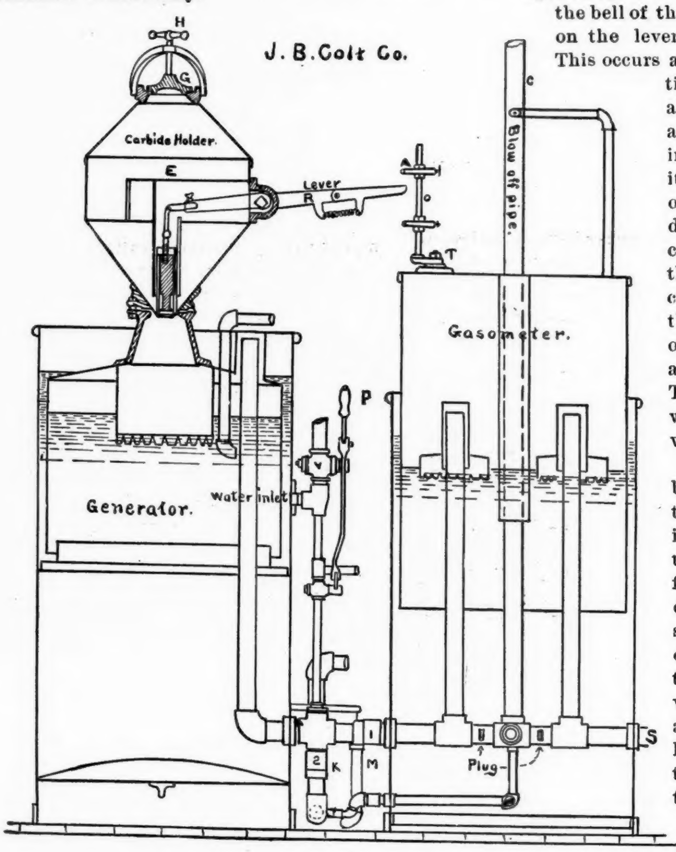



FIG. 1.

The machine must also generate "cool" gas, and wash it sufficiently to prevent any of the products of generation being carried into the pipes or burners and clogging them. These requirements are successfully met in practically all the machines now in the market which have been accepted by the insurance authorities. There are also mechanical considerations such as well constructed tanks, secure piping, simple regulation, convenient arrangements for cleaning and charging, some form of indicator showing when recharging is necessary, a maximum generation of gas from the carbide, etc., which are of importance, though not strictly appertaining to the principles of using acetylene.

To illustrate the workings of the "Carbide to Water" class of machines, the one made by the B. J. Colt Co. is described. Referring to the illustration, a charge of carbide in the form of small granules, is placed in the holder, the lower end of which is V shaped with a valve at the bottom. The valve is opened by the lever *R*, when the stud *A* on the top of the bell of the gasometer sinks low enough to press on the lever, thus raising the plunger of the valve. This occurs at periods varying with the consumption of gas. The opening of the valve allows a small quantity of the carbide at the lower end of the holder, to drop into the receptacle immediately under it, which contains water and generation of gas follows, filling the chamber under the holder until the pressure overcomes the resistance of the water, three inches in depth surrounding this chamber, when the gas passes through the V shaped slots in the bottom edge of the chamber, up through the water and into the pipe to the gasometer. The end of this pipe is closed with a water seal which gives an additional washing.

The generation of this gas causes the bell of the gasometer to rise, releasing the pressure on the lever *R*, and allowing the plunger to fall, closing the valve to the carbide holder and stopping the feed of carbide until the bell has again descended low enough for the upper stud to again press on the lever and open the valve. This rise and fall of the bell and opening and closing of the valve to the carbide holder continues automatically until all the carbide is exhausted. From the bell, the gas passes to the service pipe, having first passed through a filter at the top as shown in he illustration. The gas is cooled in passing through the water in the generator and gasometer, and by radiation in the gasometer, the gas being cool enough to make the latter of but little importance. The residuum of the carbide is lime, which settles at the bottom of the generator and is drawn off through a gate at suitable intervals. It will not be necessary to describe the water feed pipe valves, etc. A blow off pipe, with an opening outside the house, allows excessive gas, should any be generated, to pass away harmlessly.

The "Water to Carbide" process is illustrated by the Victoria machine. The carbide, in the form of lumps, is placed in the pans *X*, shown in Fig. 2. These pans are one third filled with carbide and placed one upon the other in the central holder, which is of a little greater diameter than the pans. The pans, varying in number according to the size of the machine, have perforations near the top for admitting the water. The top pan *W*, is a dummy, serving to reduce the air

space. Over the top of the pans and pan shaft is placed a dome *H*, which is securely held down by an iron bar to the movable end of which is attached a chain, wh'ch is fastened at the other end to the plug *Y*, closing the water vent pipe *Q*.

With the pans properly charged with carbide, the water is admitted at the lip *A*, of the gasometer until it has passed through the connecting pipe *B*, into the generator. Rising in the generator it reach the hole *E* in the U shaped pipe *K*, which has at the bottom a connection with the pipe *Q*, which admits the water to the chamber containing the pans of carbide.

As soon as water passes through the lowest hole in the lowest pan, and reaches the carbide, gas is generated and passes out through the higher holes and up through the space between the pans and pan shaft,

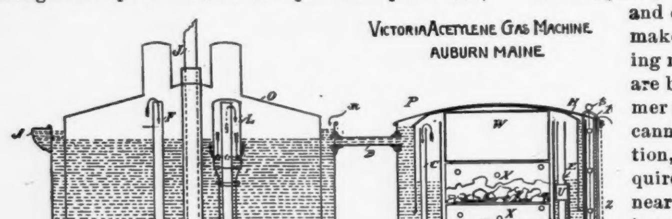



FIG. 2.

over the top of the latter and into the pipe *C* to the gasometer. The opening of this pipe in the gasometer is covered by the regulator *L*, which has a closed top and perforations located about seven inches below the water level. When sufficient gas has generated to create a pressure sufficient to overcome the resistance of this depth of water, the gas passes through the holes in the regulator, up through the water and into the gasometer, the bell of which rises as generation continues. Unless the gas is being consumed as fast as generated the bell continues to rise, releasing the lever *I*, allowing the regulator to drop to its seat, increasing the gas pressure in the dome sufficiently to cause the water in the generator to fall below the opening *E*, and thus stops the feed of water to the carbide, and the generation of gas, until enough gas has been consumed to lower the bell, raise the lever and regulator. This reduces the pressure so that the water will again rise to the opening *E*. The valve, *U*, is for closing the opening, *E*, when the u e of the machine is to be discontinued for any purpose. The outer branch, *K* of the U shaped pipe contains a rod upon which are small cups. The water rises in these cups to the same height as in the pan shaft. By lifting out the rod and seeing which cup is wet, the pan in which the carbide is then being used can be at once determined.

When all the carbide has been consumed and recharging is necessary, the plug *Y*, is removed allowing the water in the pan shaft to pass into the drain pipe. The dome is then lifted off, the pans, now containing only lime, are taken out, emptied, washed and recharged, put back in the pan shaft, the dome and plug, *Y*, replaced, a little water run into the lip *A*, and the machine is again ready for another run.

The simplicity which characterizes the construction and operation of acetylene gas machines, makes them particularly suitable for lighting residences, factories, hotels etc. They are becoming deservedly popular for summer residences, as there are no parts which cannot be easily protected from deterioration, are not expensive to install, and require but little attention to operate. The near future will undoubtedly see a widely increased use of this system of illumination.

## TRADE NOTES

The Atwater Kent Mfg. Works, Philadelphia, Pa., manufacturers of the well known Monoplex telephones, are now ready to fill orders for a line of inter-communicating telephones after the simple yet efficient design which characterizes the Monoplex. There are three different designs, a selective ringing system with three wires and one additional wire for each station. Six stations would require nine wires. A single central battery supplies current for both ringing and talking.

Another system is non-selective but fully inter-communcating. But four wires are required, and all bells can be rung from any station. A code of signals for different persons is used with this system, the person wanted answering from the nearest station. A central battery is used with this system.

The third system is a radial one, all stations being connected to a central, but not with each other. A central battery is used. The company also make an inexpensive impedence coil for use with the two first systems.

These instruments should meet with a large sale as they are quite suitable for factory or store use and sold at a cost, considering their quality, which is very reasonable.

See the Grand Prize proposition on editorial page.